Colorado
INNOVATION REPORT
Accelerating Colorado's Entrepreneurial Momentum
2013

Colorado
Office of Economic Development and International Trade

COLORADO™ innovation network

Colorado State University

STATE OF COLORADO 1876

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Executive

SUMMARY

Innovation is key to economic growth. Each year, the Colorado Innovation Network issues a report on Colorado's innovation performance, which is based on an objective analysis performed by a research project team at Colorado State University, led by Dr. Stephan Weiler. The inaugural report was issued in August 2012 and provided a baseline index of Colorado's innovation performance under a framework of ideas, talent, capital and entrepreneurship. Ideas, talent and capital represent the components necessary to generate raw innovation, while entrepreneurship represents the generation of value from these raw components in the marketplace. This 2013 report builds on those metrics to highlight where potential opportunities exist to ensure Colorado's continued competitiveness as an innovative state. These metrics are used to compare Colorado's performance to both the national average and a set of benchmark states. These benchmark states consist of California, Massachusetts, North Carolina, New York, Utah, Texas and Arizona. These are the states utilized in the 2012 report and have been maintained for consistency.

2013 REPORT HIGHLIGHTS

ENTREPRENEURSHIP

Entrepreneurship plays a key role in the economic development of a state.

- Colorado's reputation as an "entrepreneurial" community is well founded given its self employment breadth and business density, which is well above the national average as well as highest among benchmark states.
- There is a national trend towards an increased share of non-employer establishments (i.e. those establishments having no paid employees and generally in the form of a sole proprietorship, partnership or corporation). True to its reputation, Colorado houses a high density of all businesses, although their growth since 2000 has slowed significantly.
- Colorado continues to be competitive in number of employer establishments. Like other benchmark states and the United States as a whole, the size of these establishments at birth is declining. These smaller employer firms and larger share of non-employers suggest an emerging trend towards micro-entrepreneurs, a primary storyline of the entrepreneurship section.
- Nationally, the five-year survival rate of a small business is just slightly less than 50%. The survival profile over an establishment's critical first five years in Colorado is less than the national average, as is the profile of most other benchmark states. However, for those businesses that do survive in Colorado, employment growth, as well the income returns to both entrepreneur and the labor force, exceed the national average and most benchmark states.

Key Opportunity

Companies fail for a variety of reasons - inaccessibility of capital, inexperienced management, or an undeveloped or inappropriate approach to market. How or what can influence the success rate? This report suggests opportunities in terms of talent, ideas and capital, yet a more general response might be effective mentorship. Colorado has experienced an explosion of meetup groups, incubators, accelerators and entrepreneurial workspaces. What impact, if any, can this have on the survival rate? While the survival of companies is clearly a benefit to every economy, it is especially an advantage to Colorado given the high rate of returns to the entrepreneur and labor force. Thus, the impact of a greater density of collaborative workspaces and entrepreneurial groups is of significant interest to our community.

TALENT

A workforce rich with human capital will produce great ideas—the raw innovation that entrepreneurs will then refine into new products, processes, and services.

- Colorado is home to a highly educated workforce, in terms of both bachelor (2nd among benchmark states) and graduate degree (3rd among benchmark states) recipients.
- While competitive against other benchmark states, nationally Colorado ranks 24th out of 50 states in terms of high school graduation rates.
- Colorado outperforms the national average for STEM degree attainment, although women's STEM degree attainment has declined nationally as well as locally.
- Educated migration continues to benefit the innovation ecosystem in Colorado, although appears to be on the decline in terms of both domestic and foreign migration.

Key Opportunity

"Homegrown" talent is an advantage for Colorado but maintaining that advantage is a challenge. A consortium of leaders from government, not-for-profits, and education has formed a coalition to provide a STEM road-map. Additionally, programs such as Study Colorado also provide a pipeline for international migration. Collaborations such as these provide for a complete and cohesive approach to developing, improving and increasing Colorado's innovative competitiveness.

IDEAS: RESEARCH AND DEVELOPMENT

While a talented population can generate good ideas that entrepreneurs foster and develop to create value in the marketplace, research and development is critical to the continuing flow of such marketable ideas.

- Colorado's ability to secure public funding for research is slightly above the national average, and university/nonprofits are also slightly ahead of the nation in terms of R&D activity.
- Nationally, private business contributions to research and development represent over two-thirds of the total research and development funding. Colorado, while ahead of other benchmark states, is below the national average and significantly behind leader benchmark states.

Key Opportunity

With more than 20 federal labs, several major research universities and a thriving business community, Colorado has a key advantage over many other states to foster and grow this "idea pool". While the presence of such institutions has a positive impact on Colorado's economy, opportunity exists for Colorado to explore increased business contributions to research and development.

CAPITAL

Access to early investment is critical to the viability of new ventures and growth companies.

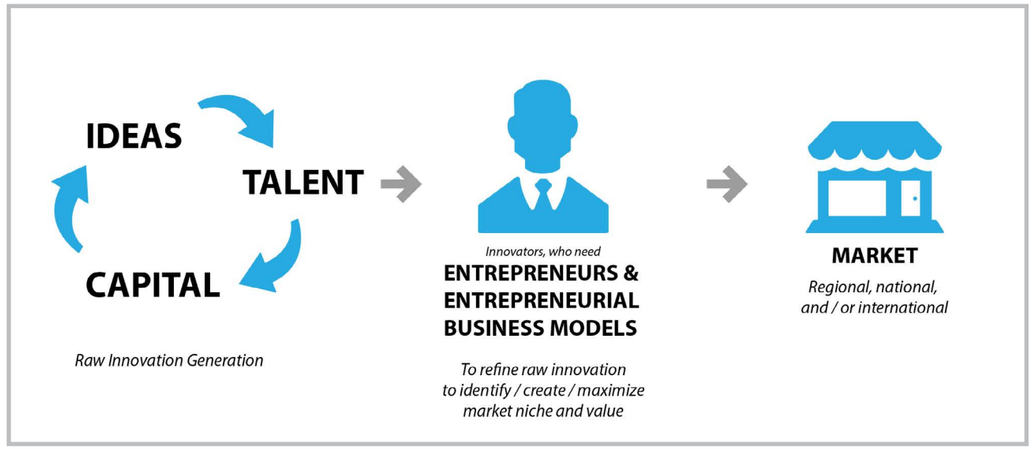
- Bank loan, venture capital, and initial public offering data indicate that Colorado's capital market in general mirrors the national trend downward since the Great Recession, and are particularly weak in terms of the average amount of financing.
- The relatively large number of bank branches and community banks per capita suggests Colorado has potential longer-term advantages for strong relationship lending.

Key Opportunity

A commonly cited disadvantage for Colorado, inaccessibility to entrepreneurial financing, creates significant barriers. The need to reexamine and expand avenues has been recognized nationally with the passing of the Jumpstart our Business Startups (JOBS) Act. In light of the delay in regulation by the Securities Exchange Commission, certain states have enacted their own regulations to allow the sale of equity to non-accredited investors that are residents of those respective states via crowdfunding. Colorado's acknowledgment of this critical need came in the form of HB13-1001, the Advanced Industries Accelerator Act, which provides proof of concept, early stage, and infrastructure grants to companies and institutions operating within seven industries.

INTRODUCTION

The Colorado Innovation Network (COIN), established in 2011 by Governor John Hickenlooper, aims to support and improve the Colorado innovation ecosystem. In collaboration with Colorado State University (CSU), COIN issued the 2012 Colorado Innovation Index with the intention of establishing a baseline performance of one particular asset – innovation. Innovation is a product, process, or service that generates new value in the market place. The inaugural report established a framework to track innovation performance. Talent, ideas, capital, and entrepreneurship are the four components of this framework and jointly determine the innovative capacity of an economy. Ideas, talent, and capital represent the components necessary to produce raw innovation while entrepreneurs refine and match these innovations with market niches.



Colorado's performance under this framework will effectively highlight opportunities to strengthen its innovative ecosystem. For purposes of consistency, we continue to leverage the same benchmark states from the inaugural report, including Arizona, California, Massachusetts, New York, North Carolina, Texas and Utah. These states are known either as innovative hotbeds, such as Massachusetts or California, or are regional neighbors with similar aspirations, such as Utah and Arizona.

THE 2012 REPORT PRODUCED FOUR BROAD CONCLUSIONS:

- Small business is a crucial comparative advantage for Colorado, as well as a critical conduit for refining and matching raw innovations to the marketplace.
- Colorado's highly educated workforce is a comparative advantage that is most effective when leveraged in conjunction with other assets.
- Nonprofits and universities have an above-average amount of research and development activity, and Colorado outperforms many benchmark states in patent issuance.
- Colorado has an attractive tax climate, but most forms of early-stage capital have declined sharply in parallel with other states.

This year's report will take a step toward better understanding the components' underlying metrics and their trends by examining particular components in greater detail. It will develop the concept of "micro-entrepreneurs," reflecting the millennial trend towards proprietor-led non-employer establishments, smaller employer establishments, and the associated popular perception of a lean "free-agent" workforce where each worker is his/her own company. In that spirit, the 2013 effort will update existing metrics from the inaugural report in a new dedicated website (innovation.colostate.edu) and use several key metrics to help anchor the year's report. This report will pay particular attention to trends emerging from the Great Recession. Ultimately, the goal of this report is to go beyond the conventional metrics used in most other entrepreneurial ranking reports so that opportunities to influence and strengthen Colorado's innovation trajectory are brought to the surface.

The report's data reflects the most up-to-date publicly available statistics. Furthermore, the most recent available year is generally compared to 2000 as the primary anchor year, as well as 2009 to clarify the trend since the bottom of the Great Recession in late 2008. The charts illustrate the COIN metrics across three contrasting dimensions: relative to the United States, across the peer group states, and over time.

ENTREPRENEURSHIP

Colorado has justifiably been recognized as being "entrepreneurial," with a high degree of self-employment and new company births each year. Self-employment implies that the person in question owns her own establishment, whether with other employees, operating solo or with a partner. The usual focus on employers misses the often important earliest stages of enterprises, namely sole or joint proprietorships that dominate non-employer establishments. These micro-entrepreneurs are not only the earliest seedlings of potential employers, but in themselves also generate jobs through self-employment.

The following metrics strongly suggest a national trend towards micro-entrepreneurs, who are likely to be solo niche experts across a wide range of industries. This trend is congruent with the more general trend of smaller efficient scales for the size of businesses. Information technology (IT) in particular has made the need for separate accounting, human resource, and printing operations obsolete, allowing business owners to manage their establishments with far fewer administrative staff and associated costs. New niche service industries are proliferating, as IT reduces business-to-consumer transaction costs and facilitates customization. Even manufacturing, which has up until now thrived on economies of scale, large factories producing huge volumes of output, may end up becoming single-creator operations through 3D fabrication technology.

These trends all allow workers to specialize, making their skills and complementary talents the focal business model, while also allowing them to reassert some control over unanticipated income and employment variations in higher-risk/lower-return labor markets (Low and Weiler, 2012). In this sense, the parallel trends toward outsourcing and an "open-source economy" are simply a confirmation of the specialized-workforce system, where workers can themselves hire just the talent they need for particular tasks, maximizing the flexibility of the overall economic system.

"Entrepreneurship plays a key role in the economic development of a state."

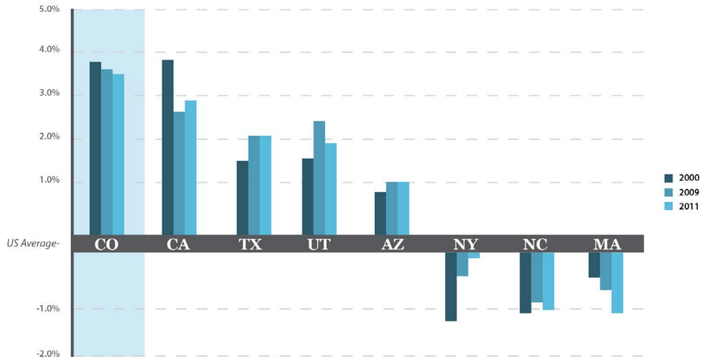
ENTREPRENEURSHIP

Consistent with its reputation, Colorado demonstrates a strong self-employment culture (Figure 1). Nationally, the percent of those self-employed has increased by slightly more than five percentage points over the period from 2000 to 2011, although has stagnated in the recovery from the Great Recession. Leading the focal states, Colorado consistently exceeds the national rate of self-employment by more than 3.5 percentage points. This metric, updated from last year's index, continues to be cited by independent studies frequently as evidence for Colorado's entrepreneurial momentum.

Figure 1:

Self Employment Breadth (Self-Employed Workers/Total Work Force)
Relative to the United States

US Average		
2000	2009	2011
15.4%	20.3%	20.6%



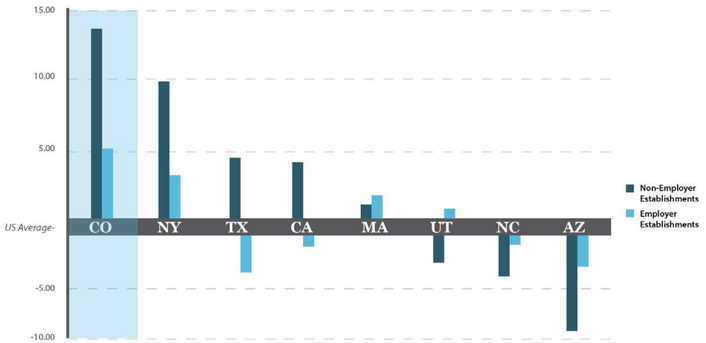
This density of self-employed Coloradans is directly reflected in the state's high business density, the number of establishments per thousand people (Figure 2). People who are self-employed are the owners of these establishments, who either simply employ themselves and their partners as owners (non-employer establishments) or who hire employees beyond their owners (small business employer establishments with fewer than 500 employees). As in the 2012 benchmark indices, we focus on those under-500-job establishments, which represent 99% of all businesses in the U.S. and are tracked by the Small Business Administration.

While innovation does occur in larger companies, our analyses benefit from the more direct tracking of innovations that generate fresh establishments and new jobs. Small businesses create nearly two-thirds of net new private sector jobs in the U.S., employ 40% of high-tech workers and produce 13 times more patents per employee than large firms[1].

Figure 2:

Small Business Density Per 1000 Residents: 2011
Relative to the United States

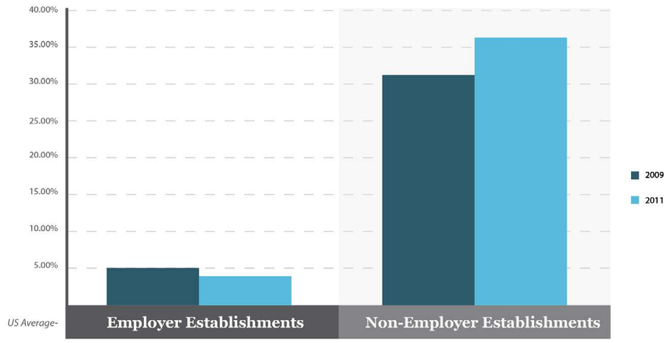
US Average	
Non-Employer Establishments	Employer Establishments
72.18	23.54



[1] *2012. "The Small Business Economy 2012." U.S. Small Business Admin., Office of Advocacy.*
"The Office of Advocacy: The Voice for Small Business in Government." Small Business Administration, Office of Advocacy

Figure 3:

United States Cumulative Change in Employer and Non-Employer Establishments since 2000 as percent of 2000 Levels



Non-employers make up just over 75% of businesses in the U.S. (Figure 2). Along with Figure 2, Figure 3's growth graphics underscore non-employers' overwhelmingly large and accelerating role in the dynamic American business landscape. These sole or joint partnerships are by their nature "micro-entrepreneurs," providing employment for their owners while laying the seedbed for future employee hiring as they mature. During the period from 2000 to 2011, the growth in non-employer establishments dramatically outpaced the increase in employers. During the first phase of the recovery from the Great Recession (2009 to 2011), employer establishments actually went into overall decline, whereas non-employers continued to demonstrate remarkable growth.

Figure 4:

Change in Non-Employer and Employer Establishments: 2011 as a percent of 2000 Levels
Relative to the United States

US Average	
Non-Employer Establishments	Employer Establishments
36.06%	4.04%

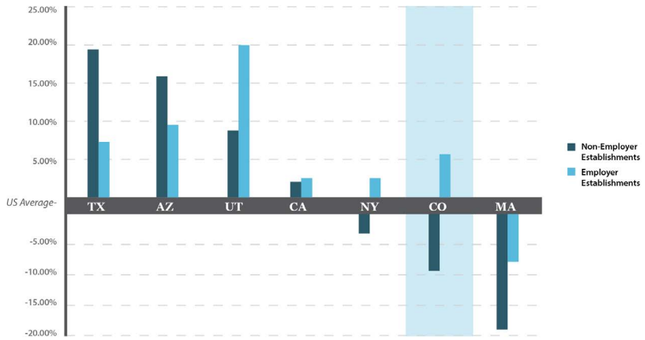


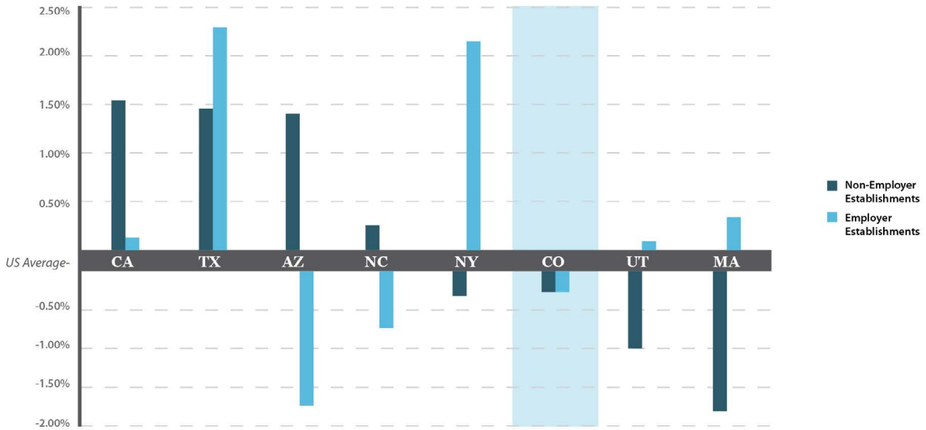
Figure 4 shows how each state differs from the national trend toward non-employer establishments described in Figure 3. In this figure, the changes in the number of non-employer and employer establishments are shown relative to their levels in 2000 as a difference from the national average. There is significant variation in the pattern of establishment growth since 2000 across the focal states. Surprisingly, given its entrepreneurial reputation, Colorado's growth in non-employer establishments is slower, precisely those that are otherwise dominating growth trends nationally. The state fares better in employer growth, suggesting relative success for more mature enterprises, but still less so than its neighbors (Arizona, Utah, and Texas) in a sector more generally showing signs of significant slowing nationwide.

Figure 5:

Change in Non-Employer and Employer Establishments: 2011 as a percent of 2009 levels

Relative to the United States

US Average	
Non-Employer Establishments	Employer Establishments
3.67%	-1.07%

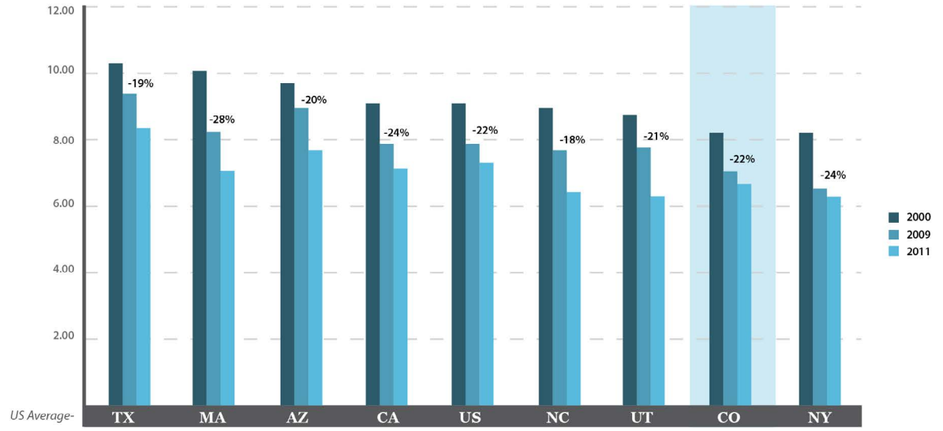


The change in the number of non-employer and employer establishments is shown again in Figure 5, but the evolutions are presented relative to their levels at the depth of the recession in 2009. Consistent with Figure 4, it is evident that even since the recession, Colorado is still slightly behind the national growth of non-employer establishments. Employer establishments, however, declined nationally by nearly 1%, and Colorado employers declined just slightly more.

Figure 6:

Average Small Business Size at Birth

Establishments with less than 500 employees



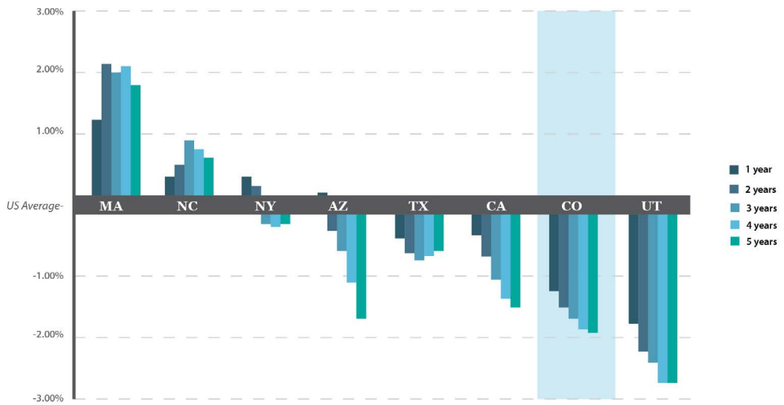
Non-employers have clearly comprised most of the increase in new establishments since 2000, suggesting an overall transition toward leaner micro-entrepreneurial businesses. Employers, though fewer in number, also suggest this transition to leaner establishments with their employment patterns. Figure 6 shows the average number of people employed by a newborn employer enterprise. In 2000, employer establishments started with 8-10 employees on average, but start-up size has fallen by roughly two workers across all focal states and nationally. The decrease was also large in Colorado, down 22% since 2000. Both the national and state data indicate that the trend towards micro-entrepreneurs, whether in the form of non-employers or significantly smaller nascent employers, is in fact quite clear.

ENTREPRENEURSHIP

Figure 7:

Small Business Survival by Age
Establishments with Paid Employees Born Between 1996 and 2006
Relative to the United States

US Average				
1 Year	2 Years	3 Years	4 Years	5 Years
78.87%	67.96%	59.86%	53.47%	48.07%



The likelihood that businesses survive decreases over time as less hardy establishments fall to competitive, cyclical, and structural pressures. For businesses born between 1995 and 2005, Figure 7 shows the survival rate by age for the first five years. In the U.S., nearly 79% percent of establishments survive the first year of business, but just 48% survive to five years. Relative to the U.S., the survival rate of Colorado businesses is low and gets worse as they age. At the end of one year, the survival rate of Colorado businesses lags behind the national average by more than one percentage point. By age five, the survival rate of Colorado establishments is even further behind, lagging by nearly two percentage points.

Increasing the survival rate of Colorado companies is clearly an interest, and given the success rates in terms of returns to the entrepreneur and returns to labor, is a clear advantage for Colorado. Culture plays a critical role in fostering the entrepreneurial community. Initiatives such as COIN's Glorious Failure: In Search of Success Innovation Challenge is an example of how supporting and promoting culture aids in the success of entrepreneurs. The challenge focused on the promotion of responsible risk taking and a tolerant culture. Additionally, all over the state of Colorado, there is an increased emergence of meetup groups, entrepreneurial work spaces, incubators and accelerators. Each is different from one another but each plays a unique and important role in cultivating a culture that fosters entrepreneurs. While difficult to forecast success, Colorado appears to have a distinct advantage as the presence of these types of communities far exceeds other benchmark states.

Ecosystem of Collaboration and Information Sharing

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A thriving entrepreneurial and innovative environment, or "ecosystem," concentrates and harnesses the energy, creativity and drive of entrepreneurs and provides an environment that cultivates more innovation and entrepreneurial success. One integral component of a robust ecosystem is a network of resources for entrepreneurs and innovators that involve the knowledge and experience of other entrepreneurs and connections with mentors and leaders, investors, suppliers and other businesses. Networks enable entrepreneurs to collaborate, share information and learn from others, both from their successes and failures. Important resources in this network are collaborative workspaces, including "coworking" spaces, business incubators and accelerators, and frequent dynamic networking events involving individuals from the entrepreneurial community.

Incubators and accelerators provide startup businesses assistance from seasoned entrepreneurs and other mentors to help guide entrepreneurs in the development of their business. They also help entrepreneurs make contacts in the business and investment community and sometimes invest in new ventures to help bring ideas to the market. The environments of incubators and accelerators also generally include a shared space with other business startups, which fosters the exchange of ideas and resources. "Coworking spaces" are similar in that they provide shared space in which businesses can operate, however, they generally provide less direct technical assistance to businesses and are not involved with investing in business ventures.

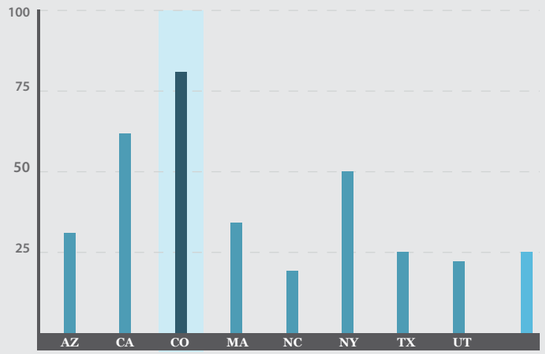
The interest and growth in collaborative workspaces has been enabled by the increasingly information- and knowledge-intensive economy, as well as global high speed Internet connectivity and mobile technology. Colorado is successfully participating in this "new" economy in many regions due in part to its high level of human capital and knowledge workers.

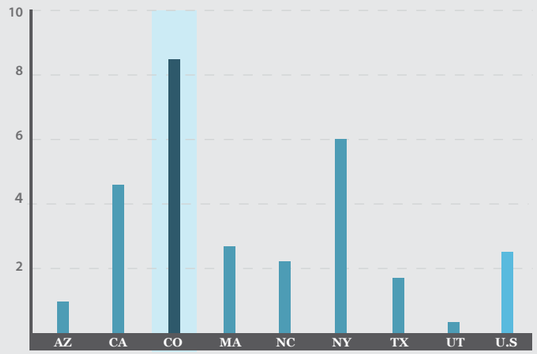
Colorado has benefited from having several entrepreneurial leaders who recognize the value of a network of resources for entrepreneurs and innovators. When comparing to the benchmark states utilized throughout the COIN Innovation Report, Colorado has the highest amount of entrepreneurial-related networking groups per one million people that use the social networking website Meetup, as well as the highest amount of collaborative workspaces (including incubators, accelerators, and coworking spaces) per one million people, according to Deskwanted, GmbH, a global network of collaborative workspaces. The figure included compares the concentration of entrepreneurial-related networking groups and collaborative workspaces in Colorado with benchmark states, as well as the nation as a whole.

Entrepreneurial Networking Groups (per 1 million people)

Collaborative Workspace (per 1 million people)

Colorado leads benchmark states and the nation overall in its concentration of Collaborative workspaces and entrepreneurial networking "Meetup" groups, indicating a robust ecosystem to help foster levels of entrepreneurship.





Source: Meetup; Deskwanted, GmbH; Population Data from U.S. Census Bureau

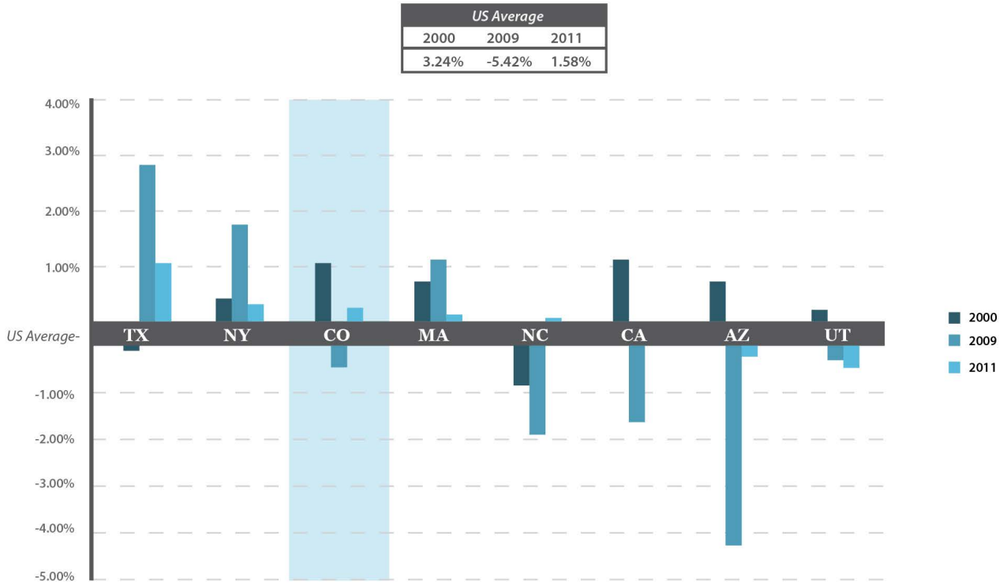
Colorado's growing ecosystem of networks, events, and collaborative work environments is a crucial reason why it is increasingly becoming a hotbed of entrepreneurial and innovative activity that has helped the state's economy outperform the nation as a whole.

This momentum improves the perception that an area has higher prospects for success for business startups. Heightened perceptions are integral as they can generate further growth in entrepreneurship and innovation by inspiring new entrepreneurs and leaders, attracting more talented workers, and signaling to investors that their capital is likely to earn strong returns in the community. Studies consistently find that a powerful predictor of future entrepreneurial activity in a region is the presence of existing businesses that have demonstrated success. Thus, it is important for the state's networks of resources to continue to strengthen in order to engage and help more entrepreneurs and innovators succeed within Colorado.

ENTREPRENEURSHIP

Figure 8:

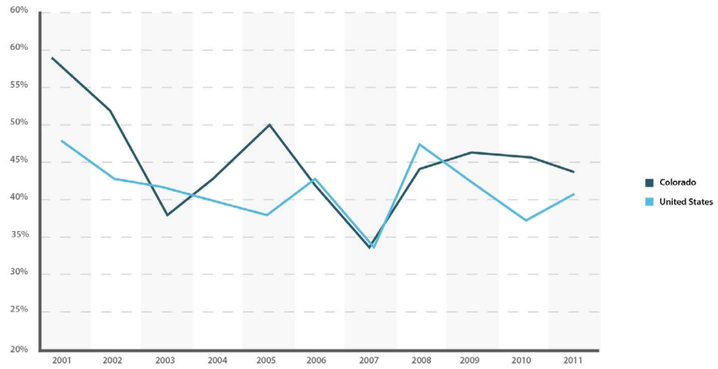
Net Job Creation Rate Establishments With Less Than 500 Employees
Relative to the United States



The small business net job creation rate is determined by the number of jobs created by establishments with less than 500 employees less the number of jobs eliminated by establishments within this category (Figure 8). The national trend turned down sharply during the recession but is slowly recovering as seen from the respective 2009 and 2011 net job creation rates. Colorado is roughly following suit, and has returned to pre-recession levels above the national average despite below average performance at the depth of the recession in 2009. In fact, the survival graphic (Figure 7) emphasizes one reason for this relatively weak performance, namely that Colorado establishments have an increasingly hard time surviving the critical first five years, leading to consequent job losses.

Figure 9:

Five-Year Employment Growth (Conditional on Survival)
Colorado and U.S. Small Businesses Born Between 1996-2006



Though business survival in Colorado is lower than the national average, those establishments that do survive grow more successfully. Figure 9 shows that after five years, small businesses in Colorado generally add as many or more employees than their counterparts in the rest of the country. For example, Colorado small businesses that were five years old in 2011 had increased hiring by 44%, while their national counterparts added 41% more jobs.

Figure 10:

Returns to Entrepreneurship: 2002 and 2007
Relative to the United States

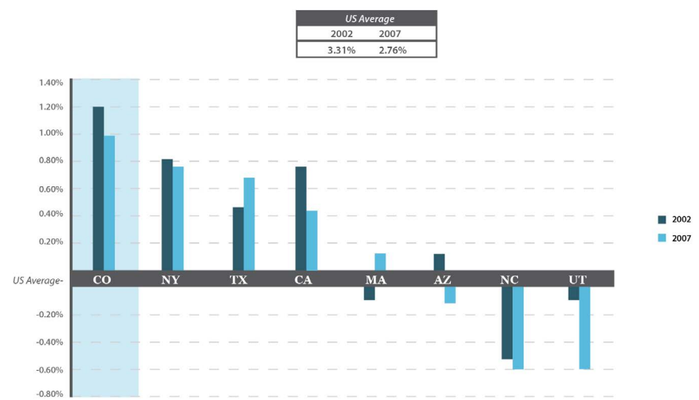
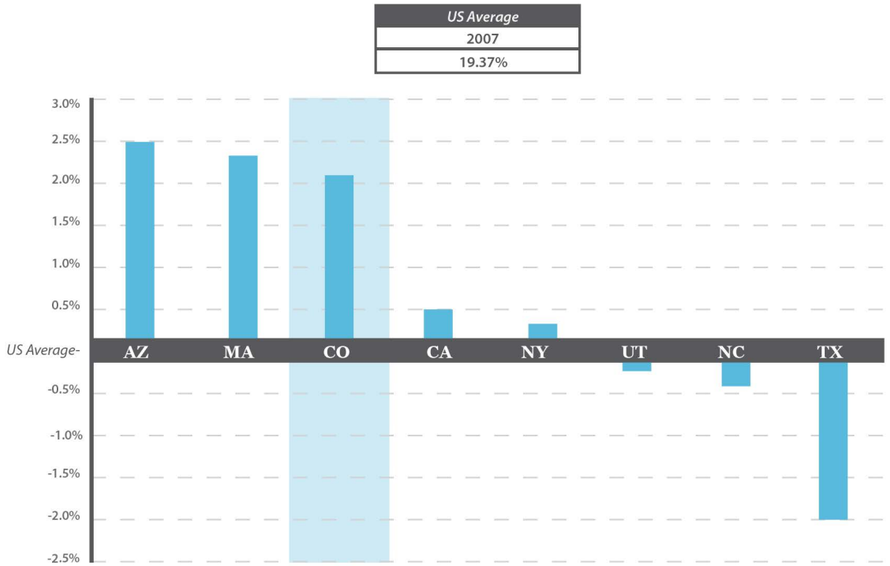


Figure 10 measures entrepreneurial depth, the percent of total sales kept as income by business owners. This year the metric has been revised to include non-employers. Colorado is the clear leader among the focal states in providing income to its entrepreneurs, reflecting the market's premium for the state's entrepreneurs' value-added, consistently outpacing the national rate by over 30%. As in the previous figure, this metric demonstrates that Colorado establishments that do succeed in the struggle to survive their early years yield significant benefits to their owners – as well as their workers, as will be highlighted in the following graph.

Figure 11:

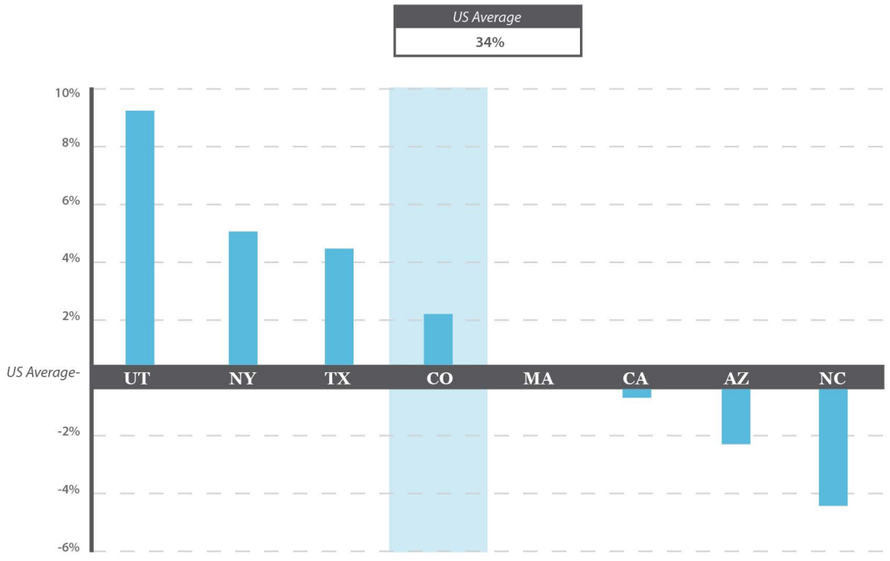
Returns to Labor: 2007
Relative to the United States



In addition to generating high returns to entrepreneurs, Colorado also generates high returns to labor (Figure 11), ranking third among the focal states. In 2007 (the most recent year available), small businesses in Colorado paid wages equal to 21% of receipts, 2 percentage points more than the national average, emphasizing the skills and value of the state's workforce.

Figure 12:

Decrease in Business Filings of Bankruptcies: 2009-2012
Relative to the United States



Furthermore, Colorado businesses are rebounding relatively robustly from the Great Recession. National business filings of bankruptcies (Chapters 7, 11, 12, and 13) have decreased substantially (34%) since the height of the financial crises in 2009 (Figure 12), yet in Colorado they have decreased by over 36%.

There is a national trend towards micro-entrepreneurs, which Colorado largely shares. The more troubling statistic is the clear struggle of early-phase Colorado businesses to survive. Yet this challenge also presents a unique opportunity, especially given that those enterprises that do survive are remarkably successful in terms of creating jobs, as well as generating returns to their owners and incomes for their workers.

Given this opportunity at the entrepreneurial nexus between raw innovations and market value, we now turn to Colorado's innovation system to consider how the three components that generate those vital innovations (Talent, Ideas, and Capital) might usefully be addressed to maximize the states' small businesses chances for success.

TALENT

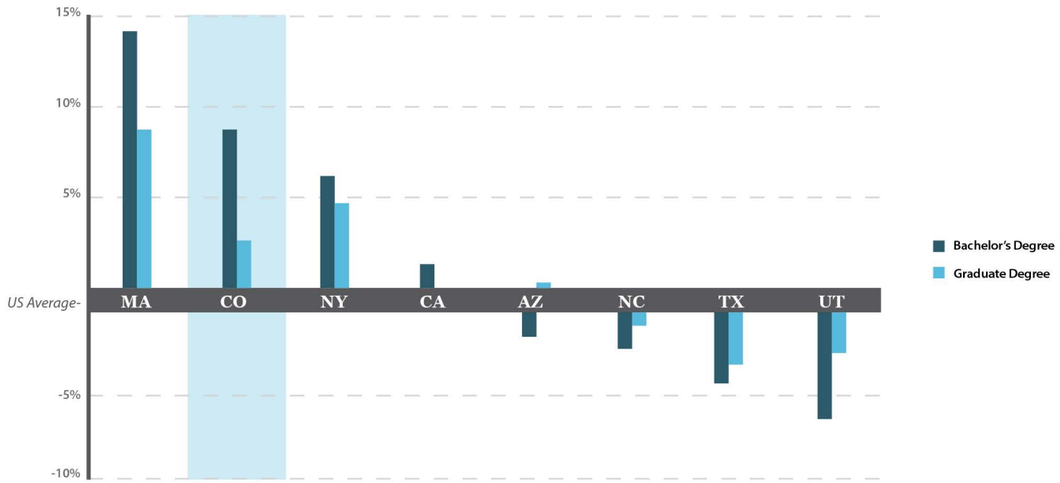
A workforce rich with human capital will produce great ideas—the raw innovation that entrepreneurs will then refine into new products, processes, and services. A talented workforce is equally as valuable for employers. Local talent is fostered by a productive education system, but talented people may also be attracted from other areas. This section measures Colorado's workforce educational qualifications, the in-state pipeline of that talent, as well as migration patterns which allow flows of talent from other states and nations.

"A workforce rich with human capital will produce great ideas—the raw innovation that entrepreneurs will then refine into new products, processes, and services."

Figure 13:

Education of Workforce: 2012
Relative to the United States

US Average	
Bachelor's Degree	Graduate Degree
34.25%	12.07%

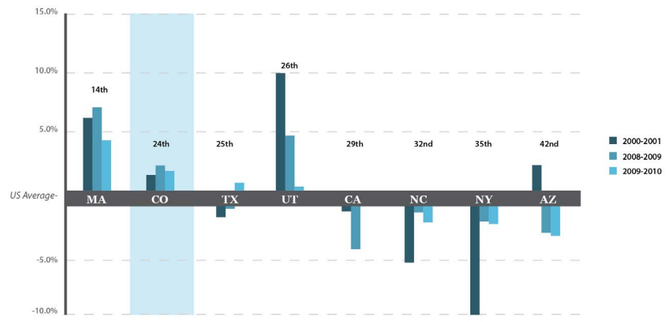


As highlighted in the inaugural index last year, the Colorado workforce is relatively well educated with over 40% of the workforce having at least a bachelor's degree (Figure 13). A Complete College America study suggests that by 2020 nearly 70% of all jobs in Colorado will require a career certificate or college degree. Among the focal states, Colorado sits behind only Massachusetts and well above the national average by this standard. Yet success in tomorrow's economy will require an even more broadly skilled workforce.

Figure 14:

High School Graduation Rank and Rates
Relative to the United States

US Average		
2000-2001	2008-2009	2009-2010
71.70%	75.50%	78.20%

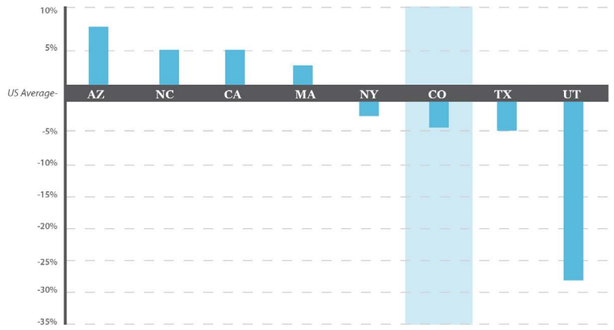


The traditional gateway to higher education is a high school diploma. Over the past decade, the share of high school students who earn a degree has increased to 78% nationally (Figure 14). Colorado has consistently been slightly ahead of the national average and is a leader among the focal states. In 2010, nearly 80% of high school students had earned their diploma in Colorado. Yet, when compared to all states, Colorado ranks only in the middle, at 24th for high school degree attainment.

Figure 15:

Public College Six-Year Graduation Rates: 2006-2012
Relative to the United States

US Average
2006-2012
60.57%



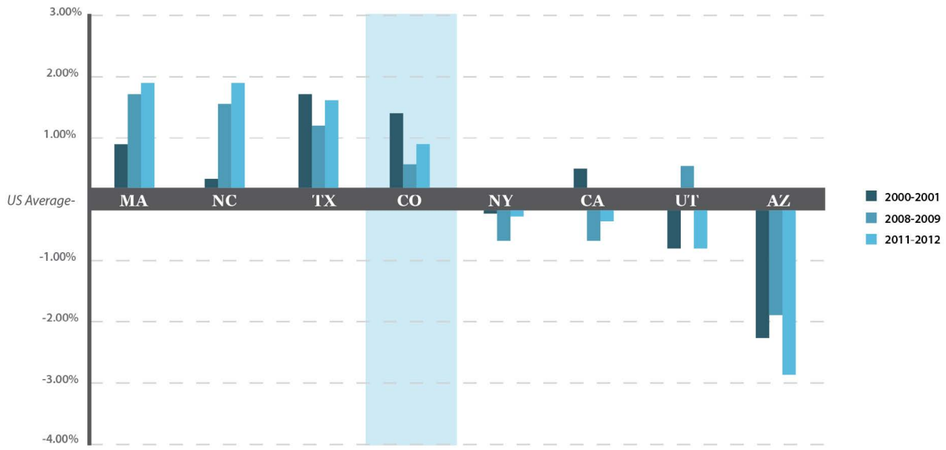
Six-year undergraduate degree graduation rates (Figure 15) from public colleges and universities also suggests concern for Colorado's pipeline, as the state falls below the national average. In the U.S., 61% of students graduated within a six year timeframe, compared to 57% in Colorado.

TALENT

Figure 16:

Share of Degrees and Certificates Awarded in STEM Fields:
2000-2001, 2008-2009, 2011-2012
Relative to the United States
Excludes University of Phoenix-Online Campus

US Average		
2000-2001	2008-2009	2011-2012
13.35%	11.27%	11.66%



There is widespread concern that the American education pipeline is producing too few STEM (Science, Technology, Engineering, and Mathematics) graduates in particular. Colorado has consistently awarded a larger share of degrees in STEM fields than the U.S. on average (Figure 16). Though the share of degrees awarded in STEM fields has been on the decline nationally, falling roughly 2 percentage points from 2001 to 2009, it recovered slightly in 2012. In Colorado, there is evidence of a recovery in STEM as well. In 2012, Colorado awarded 12.5% of degrees in STEM fields, up from 11.7% in 2009, slowly regaining its position as a national leader in producing tomorrow's technically-proficient workforce.

STEM includes a wide range of instructional programs. However there is not a generally accepted list of specific fields to include. In the following graphics we use the Classification of Instructional Programs (CIP) system to identify STEM fields. There are seven fields included in our study, each identified by one or more two-digit CIP codes: computer and information sciences (11), engineering (14) and engineering technologies (15), biological and biomedical sciences (26), mathematics and statistics (27), physical sciences (40), and science technologies (41). Over the last two decades, the definitions and instructional programs assigned to each numeric code have evolved to reflect technological advances and new fields of study. Though this implies some variation from year to year, these graphics do capture the change in STEM studies defined in broad sense.

According to data from the U.S. Department of Labor, Bureau of Labor Statistics, STEM related occupations are expected to grow 18.6% by 2023 in Colorado, exceeding the national projection by more than 7%. Non STEM related occupations are projected to grow 16.7% in Colorado by 2023, more than 3% greater than the national average. A consortium of leaders from education, government and not for profits has collaborated on a roadmap for Colorado's STEM initiative, which will cover education from preschool through the existing adult workforce

Closing the Opportunity Gap

Colorado STEM Education Roadmap Overview
Author: Angela Baber, Colorado Legacy Foundation
colegacy.org/stem/

Through the generous support of the Gill Foundation's Gay and Lesbian Fund for Colorado, the Colorado Legacy Foundation (CLF) is engaged in a three year project to improve science, technology, engineering and mathematics (STEM) education and skills in Colorado through the development and implementation of a Colorado STEM Education Roadmap and Action Plan.

Colorado's increasingly diverse economy is a skill-based economy. 80% of all jobs in Colorado are high- or medium-skill. Over the next decade, Colorado will see an 18.6% increase in STEM occupations, substantially higher than the national increase of 11.5%. At a time when we have an increasing demand for STEM skills, we are not preparing students with these skills.

There is also a significant achievement and opportunity gap in STEM; low-income students perform two grade levels below the general school population in math and science and have lower proficiency rates than the general student population. Among minority students, there is a 13.4% gap compared to the general student population scoring at or above proficient in mathematics. Women are also vastly underrepresented in STEM occupations in Colorado. Although females make up 49.8% of the population, women represent only 29% of workers in STEM occupations.

Over this three year project, CLF joins in partnership with the Office of Governor John Hickenlooper, the Colorado Department of Education, the Colorado Department of Higher Education, the Colorado Community College System, the Office of Economic Development and International Trade, the Colorado Department of Labor and Employment, the Colorado Workforce Development Council, industry representatives and K-12 and postsecondary stakeholders to develop a roadmap for improving STEM education in Colorado in a way that sets an appropriately high bar of excellence and demands equity in opportunity for all Coloradans.

Timeline: March 2013-February 2016

Year 1
- Convene key stakeholders to develop a common vision, mission, goals and action items to improve STEM education in Colorado.
- Produce a Colorado STEM Education Roadmap and Action Plan for the state.

Year 2
- Convene stakeholders to develop definitions of effectiveness and metrics for evaluating effectiveness of STEM programs and policies in Colorado.

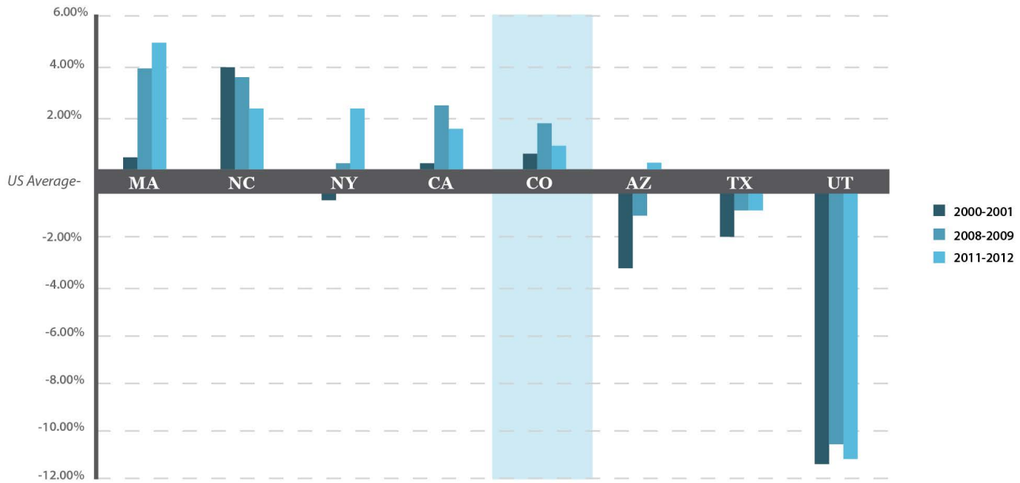
Year 3
- Establish a process by which effective programs and policies in STEM education are connected and scaled.

TALENT

Figure 17:

Share of STEM Degrees Earned by Women:
2000-2001, 2008-2009, 2011-2012
Relative to the United States
Excludes University of Phoenix-Online Campus

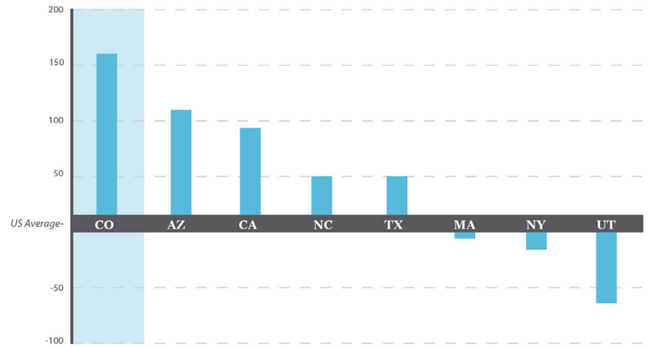
US Average		
2000-2001	2008-2009	2011-2012
33.13%	31.40%	30.58%



Women and ethnic minorities are under-represented in STEM fields. Representing half of the population and more than half of current college graduates, women are arguably a particularly promising resource for increasing the share of technically-trained graduates. The share of STEM degrees earned by women (Figure 17) has decreased nationally since 2001. In the U.S., women earned less than one-third of STEM degrees in 2012. Though Colorado still awards an above-average share of STEM degrees to women, that share fell from 33.8% in 2001 to 31.2% in 2012.

Figure 18:

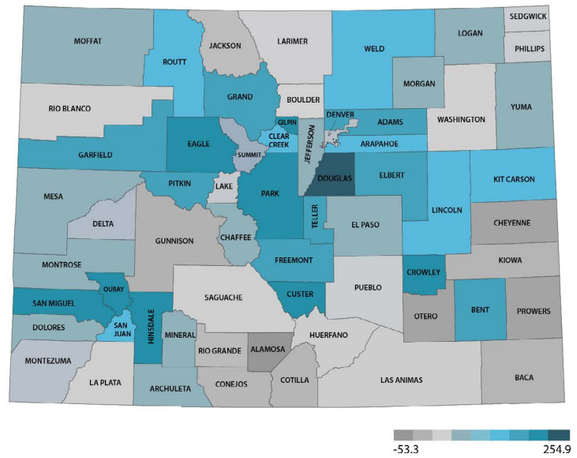
Net Domestic Migration Rate of Young, Single, College-Educated Population Aged 25 to 39 years: 1995-2000 Per Thousand People



In addition to current concentrations of Colorado talent and the in-state development of talent through the higher education system, talent can also be attracted from outside the state. The Figure 18 metric provided in the 2012 report gives an indication of Colorado's past strength in attracting talented and educated migrants from around the U.S. During the period 1995-2000, Colorado led the peer group in net-migration (outflow minus inflow of migrants) of young single college-educated adults. Colorado was an attractive place to move for the young and educated, playing an essential role in filling the talent gaps in its workforce.

Figure 19:

Net Migration Rate of People aged 25-39 during years 1990-2010 Per 100 people



To get a better understanding of migrant flows to/from Colorado, Figure 19 shows the net migration rate of young people between 1990 and 2010 by county, a two-decade span which saw a tremendous economic shift in the state towards technology incorporation and overall diversification in its industries. Although much of the focus has been on the I-25 corridor and a few select high-amenity mountain counties, the vast swath of blue in this map demonstrates that most of the state, outside of the San Luis Valley and the southeast, benefited from net inflows of young people during that groundbreaking period.

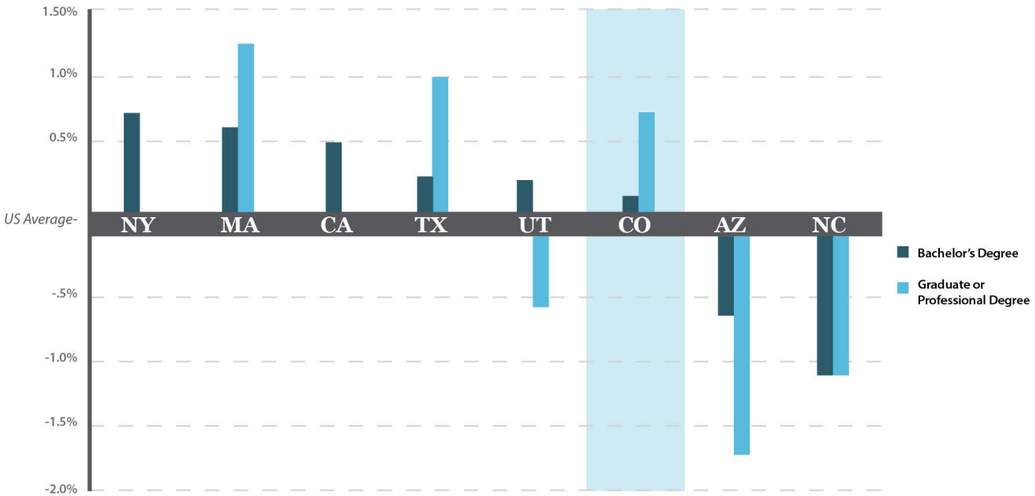
TALENT

Figure 20:

Migrants by Education Attainment, Change from 2005-2011

Relative to the United States

US Average	
Bachelor's	Graduate or Professional
-0.30%	-0.20%



A more recent look at the flows of the educated population including foreign migration shows that Colorado is no longer the leader in attracting college graduates. Figure 20 shows both domestic and foreign migrants by education attainment over the time period 2005-2011, which is primarily driven by the relatively larger number of domestic migrants. During this most recent timeframe, migration of people with at least a bachelor's degree has slightly increased in Colorado, just above the U.S. average and well below many of its peers.

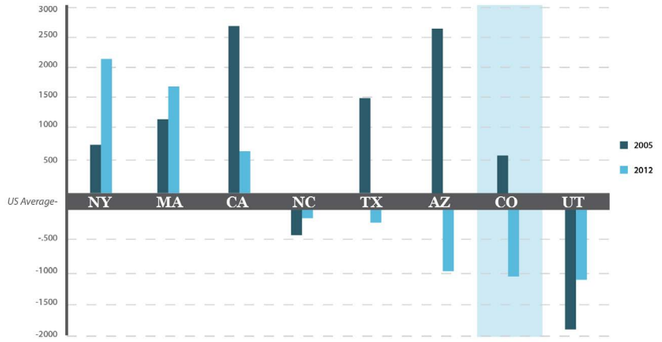
As briefly introduced above, this year's report also considers foreign in-migration in addition to domestic migrants. Immigration matters because of the substantial contribution of non-natives to innovation, in terms of talent and ideas (e.g. science and engineering publications, as in Stuen, Mobarak, and Maskus, 2012), as well as entrepreneurship; Colorado's foreign-born constitute roughly 9% of all entrepreneurs (Stiffler, 2013). Wadhwa, Rissing, Saxenian, and Rissing (2007) highlight the fact that "[t]he regions with the largest immigrant populations also tend to have the greatest number of technology startups." The April 13th 2013 *Economist* emphasizes immigrants' role by noting that "40% of Fortune 500 firms were founded by immigrants or their children, [as]were firms behind seven of the ten most valuable brands in the world. Although the foreign-born are only an eighth of America's population, a quarter of high-tech start-ups were founded by them." In addition to the clear contribution of technology-oriented foreign in-migrants, recent research has also shown that inflows of even lower-skilled foreign migrants are a complement to native workers, thus effectively creating more positions for natives in higher-wage opportunities. A study from the Colorado Center on Law and Policy suggests foreign migrants contributed $42 billion in total output to Colorado's economy in 2011.

Figure 21:

Net Foreign Migration Per Million People

Relative to the United States

US Average	
2005	2012
4052	2822



In Colorado, foreign migration occurs at relatively low rate per million people (Figure 21), falling in recent years substantially below the already-decreasing national average. Relatedly, the foreign born share of the population is also relatively low and falling (Figure 22).

The state of Colorado, its institutions of higher education and the Colorado business community developed StudyColorado in 2012 to promote Colorado as an education destination for international students. Colorado institutions enrolled close to 8,500 students from over 150 countries in 2012, and StudyColorado's preliminary analysis shows an increase of more than 5% in 2013 (with final numbers to be announced in November 2013). These students enrich our communities and teach our students to work in a global environment. Programs like this will improve Colorado's ability to attract and retain a talented workforce.

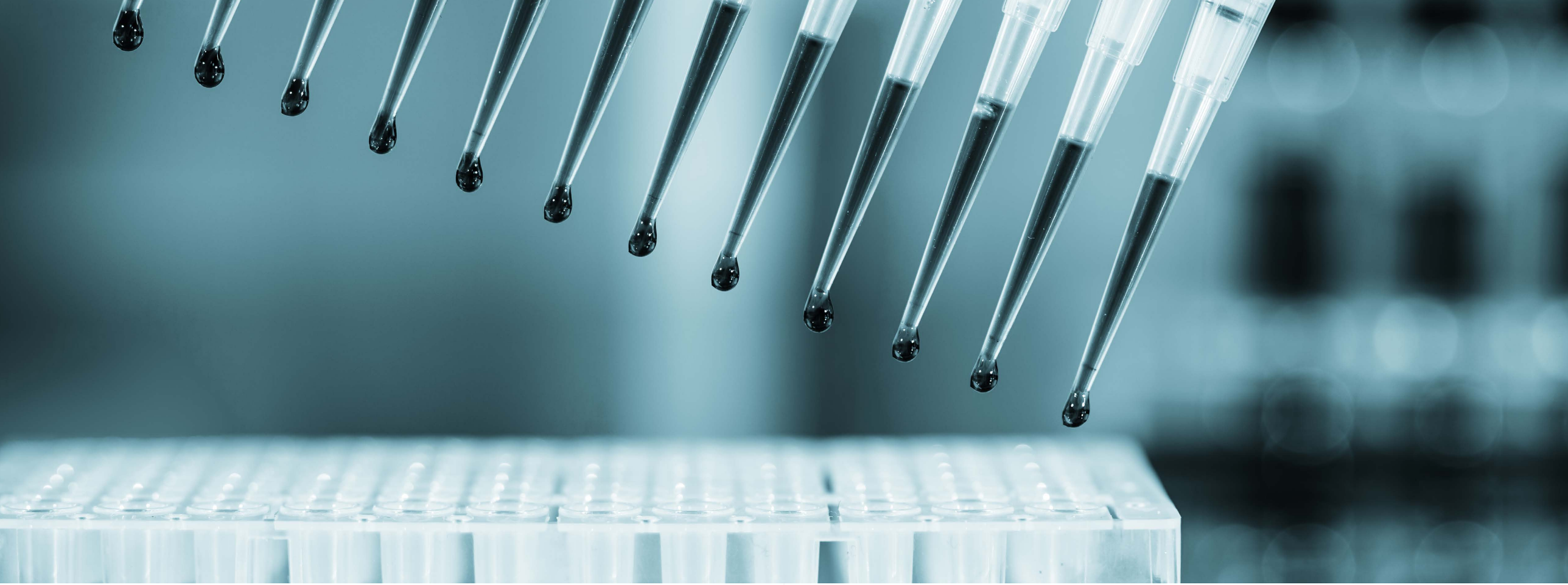
Figure 22:

Net Foreign Born as a Percent of Population

Relative to the United States

US Average		
2000	2009	2011
11.05%	12.71%	13.11%

So although its current talent base remains one of Colorado's key competitive advantages, the future is less clear as both its in-state and out-of-state talent pipelines are experiencing decline. This potentially critical innovation pothole not far down the road is all the more important because the state's especially large cohort of well-educated baby boomers will be retiring in ever greater numbers over the next 20 years (State Demographer, 2013).



IDEAS

In addition to being the source of great entrepreneurs and employees, the local talent pool generates valuable ideas. As reflected in the talent section, Colorado boasts a highly educated workforce, which includes the presence of those involved in over 20 federal labs located in Colorado. The presence of these labs provides a unique distinction for the state and is of great economic benefit.

To understand innovation, it is important to measure both the source and flow of ideas. To that end, this section measures the fundamental factor that produces the flow of ideas, namely research and development, in terms of both source funding and spending flows. The most recent data available is from 2008. While somewhat dated, this benchmark usefully occurs before the Great Recession's impact.

"The presence of these labs provides a unique distinction for the state and is of great economic benefit."

Colorado-based Federal Research Labs represented by CO-LABS contribute $1.5 billion to state economy

Author: Bill Scanlon, National Renewable Energy Laboratory

Colorado is a global leader in climate and earth science, renewable energy, photonics, astrophysics and other frontiers.

Colorado has an unusually large concentration of federal research labs that together contributed $1.5 billion to the state economy in fiscal year 2010, while sparking innovation in fields as varied as climate science, renewable energy, atmospheric science, wildlife management and disease prevention.
Over 20 federal labs and their 20 affiliates are members of CO-LABS, the non profit that informs the public about the breakthroughs, advances and impacts from their innovative work.

A survey commissioned by CO-LABS and conducted by the University of Colorado's Leeds School of Business, "Impact of Federal Research Laboratories in Colorado, 2009-2010," also found that the labs provided 16,000 jobs in the state in partnership with universities and businesses. The $1.5 billion overall economic impact was up 36% from 2007.

The next CO-LABS sponsored economic impact survey will be made public this fall. Like those conducted in 2007 and 2010, the survey will quantify the economic and fiscal impacts of federal research facilities and their affiliates by examining:

- economic benefits, such as dollars distributed through the economy
- public revenues, such as tax revenues generated, and
- public costs, such as providing government services to the labs and their employees.

"This concentration of federal labs in Colorado is a huge resource for the state, both in its contribution to the scientific community and as a driver for the economy," said Bill Farland, chairman of CO-LABS and vice president for research at Colorado State University.

Federal laboratories in Colorado range from large facilities, such as the National Center for Atmospheric Research in Boulder, to smaller ones, such as Bureau of Reclamation Technical Services Center in Denver and Centers for Disease Control and Prevention's laboratory in Fort Collins.

Together, the federal labs comprise an innovation engine for the state that connects directly with Governor John Hickenlooper's and the Colorado Innovation Network's intent to grow an innovation ecosystem that can help drive the scientific and manufacturing legs of tomorrow's economy.

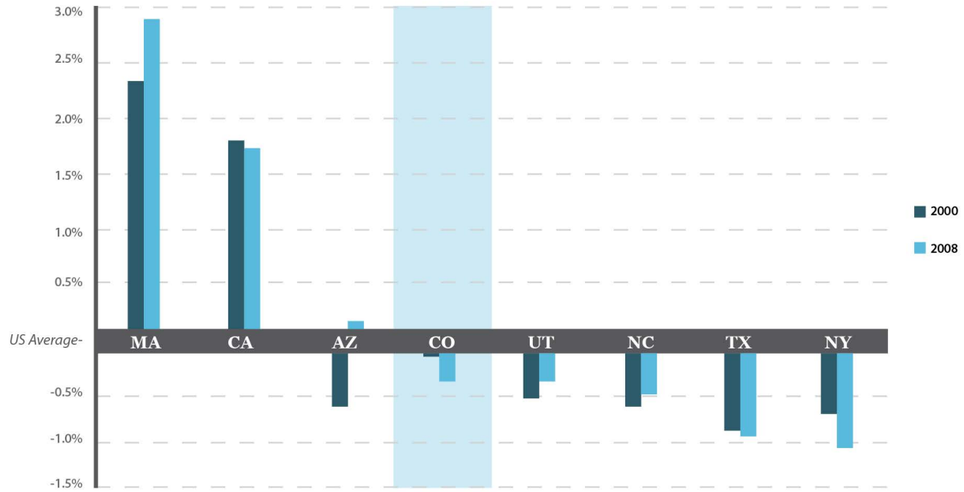
The facilities under the CO-LABS umbrella support internships and post-doctoral opportunities for students in Colorado and beyond. Together, they help ensure that Colorado fosters strong interest in science, technology, engineering and math education in K-12 and university students. Additionally, presence of the federal labs help lure bright entrepreneurs to the state.

"It's auto-catalyzing," Farland said. "The more talent we have in our labs, the easier it is to attract other talented people and businesses. There's a knowledge base in each of these facilities that is of interest to policymakers and the business community."

Figure 23:

Research and Development as a Percent of State GDP
Relative to the United States

US Average	
2000	2008
2.48%	2.61%

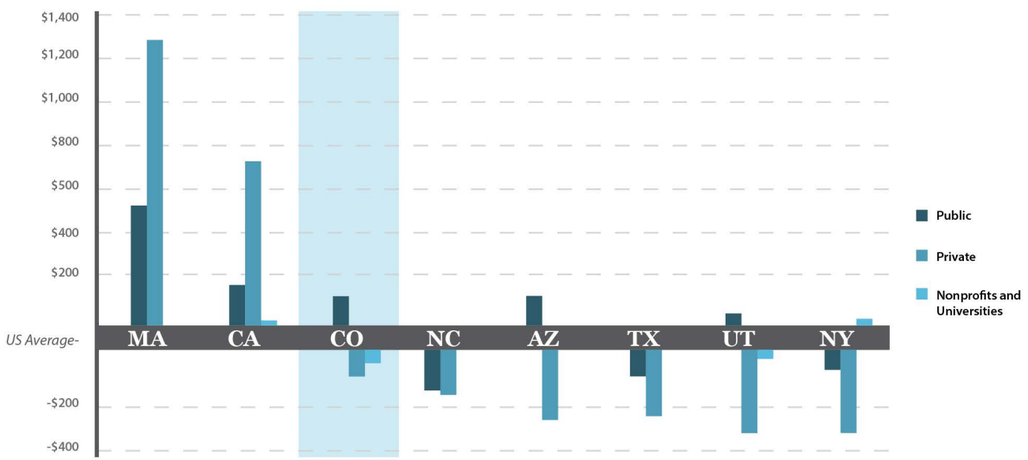


Product/service development is the key to success for enterprises. Their ability to develop cutting-edge products/services is what allows them to maintain their edge in the ever-competitive marketplace; the innovative system determines those abilities. Research and development (R&D) intensity, measured by R&D expenditures divided by gross economic activity, is the critical metric when comparing businesses' long-term innovative potential. Analogous to businesses' R&D intensity, Figure 23 shows state-wide R&D intensity levels, the sum of R&D spending within the state divided by Gross Domestic Product. In terms of research and development intensity, Colorado ranks in the middle of its peer group, but declined relative to the United Since during the period from 2000 to 2008 during otherwise growth years.

Figure 24:

R&D Funding Per Million Residents: 2008
Relative to the United States

US Average		
Public	Private	Nonprofits/ Universities
$349.54	$846.20	$48.63



Before considering spending patterns, it is instructive to review the source of these expenditures (Figure 24). In terms of R&D funding, Colorado's position is almost entirely due to shortfalls in private business contributions, which nationally represents over two-thirds of total R&D. The other major contributor is the public sector, where the state's ability to secure public (e.g. federal and state) funding is slightly above average.

Figure 25:

R&D Spending Per Million Residents: 2008
Relative to the United States

US Average		
Public	Private	Nonprofits/ Universities
$147	$956	$190

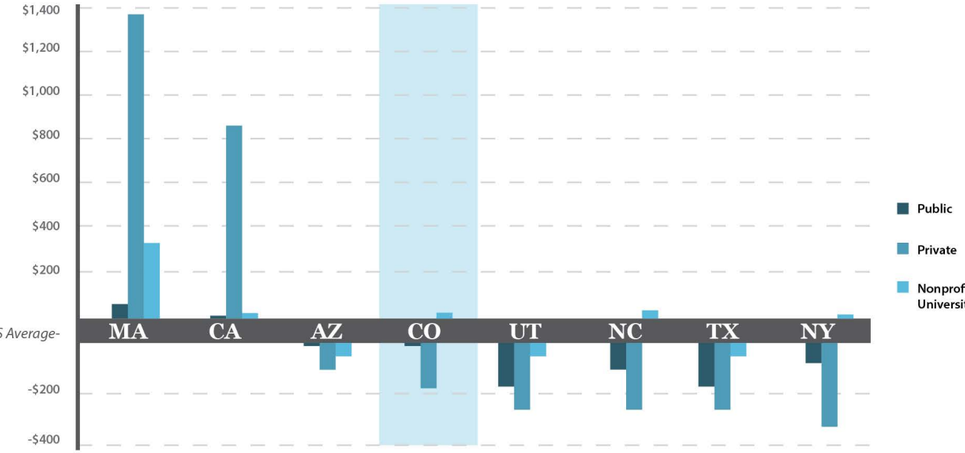


Figure 25 highlights the fact that Colorado's increasing R&D gap noted in Figure 23 is indeed primarily a function of lagging R&D in the critically important business sector, which nationally does nearly ¾ of all R&D spending. Relative to source funding, nonprofit and university spending activity is more significant, and is slightly ahead of national norms and roughly on par with similar institutions in the recognized university-R&D states of California, North Carolina, and New York.

Increased collaboration and investment by the private sector is critical for future innovative success in Colorado. While the Brookings report, "Launch! Taking Colorado's Space Economy to the Next Level", issued in early 2013, focuses on the aerospace industry, it similarly identified the "need for the state of Colorado to put an emphasis on research and development; collaboration among companies and between industry and research institutions; and the commercialization of innovation". The report defines that commitment as "creating a targeted matching grants program", which was passed by the legislature in the form of Colorado's Advanced Industries Accelerator Act, and also to create "a state-run innovation vouchers program for smaller firms seeking innovation expertise which would encourage industry-university collaboration". The innovation voucher program is still under consideration by the State.

CAPITAL

Talent and ideas aren't enough. Raw innovations must be sufficiently developed for entrepreneurs to refine and carry them into the marketplace. Adequate locally-available early-stage financing is necessary to get the most from the other components of innovation. Entrepreneurs and researchers all benefit from access to seed capital, helping to crystallize new innovations. This section assesses early-stage capital availability through banking, venture capital, and initial public offerings.

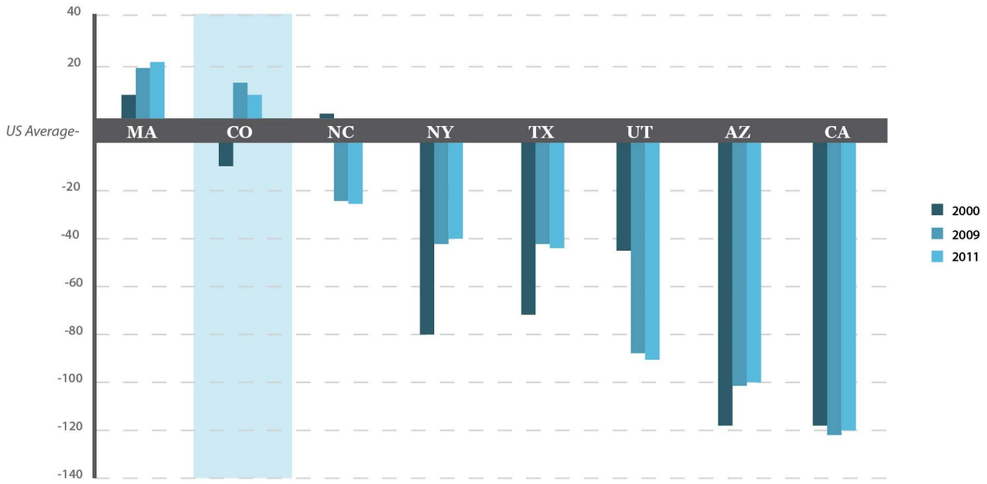
"Access to early investment is critical to the viability of new ventures and growth companies."

Figure 26:

Number of Bank Branches Per Million People

Relative to the United States

US Average		
2000	2009	2011
301	323	313



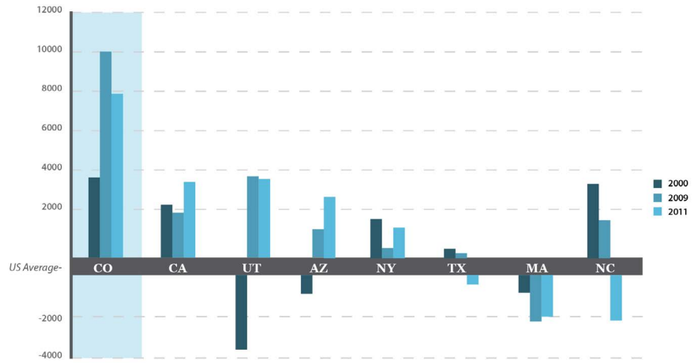
Entrepreneurial businesses will often turn to the local bank for access to capital. Banks are much more likely to lend if they have more information about the borrower. Having a large number of bank branches allows for more networking, more relationships, and more time to devote to understanding business owners and their proposed projects. Figure 26 clarifies the number of bank branches by state, using data from the Small Business Administration normalized by million residents. Colorado is a leader among the peer group in this metric, which suggests an unusually large number of potential links between banks and local businesses. The corresponding graphic for the number of community banks (i.e. those with assets less than $1 billion) per capita is remarkably similar, with Colorado leading both the nation and all benchmark states.

Figure 27:

Number of Small Business Loans Per Million People

Relative to the United States

US Average		
2000	2009	2011
14053	19019	9579



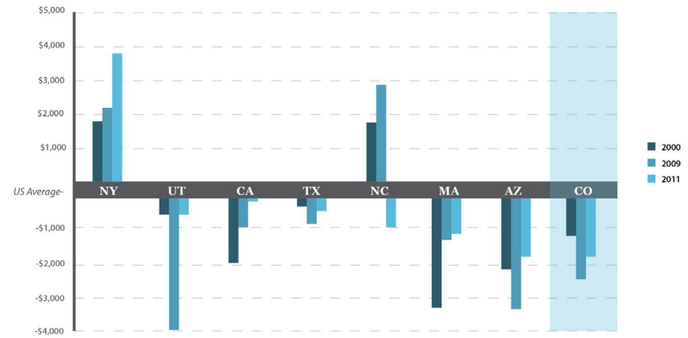
Evidence indicates that these bank-business linkages benefit Colorado businesses in terms of the number of loans they receive. Small business loans are defined here as loans less than $100,000. Normalized per million residents, Colorado has a strong record in giving out small business loans, with the state leading its peer group and the national average (Figure 27).

Figure 28:

Average Size of Small Business Loans

Relative to the United States

US Average		
2000	2009	2011
$13,085	$8,893	$18,531



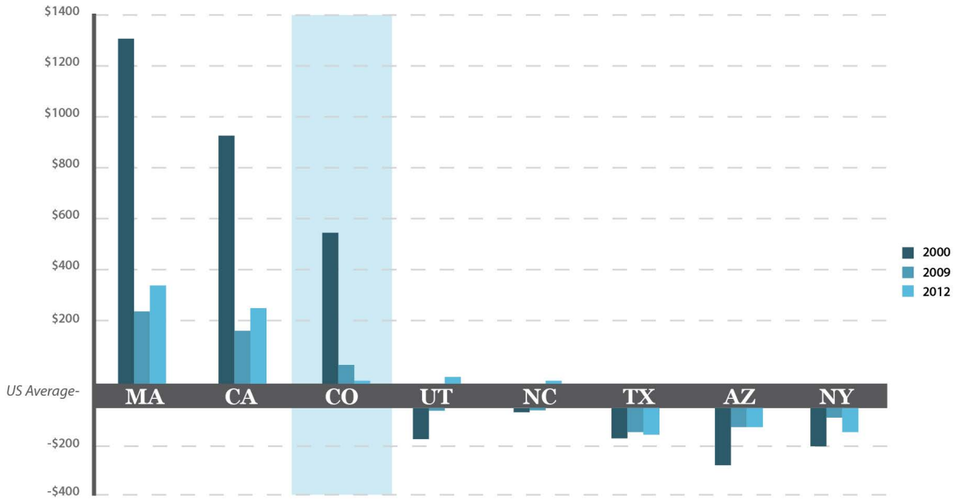
Although Colorado is leading the peer group and is well above average in the number of small business loans being made, the average size of these loans is much smaller than the national average, with Colorado also significantly trailing the peer group (Figure 28). While Colorado employer establishments are slightly smaller than the national norm, the state features a lower share of micro-entrepreneurial non-employer establishments. Thus, Colorado businesses appear to be facing a funding gap when compared to their counterparts in other states.

CAPITAL

Figure 29:

Amount of Venture Capital Funding ($ millions) Per Million People
Relative to the United States

US Average		
2000	2009	2012
$373.90	$66.44	$84.50

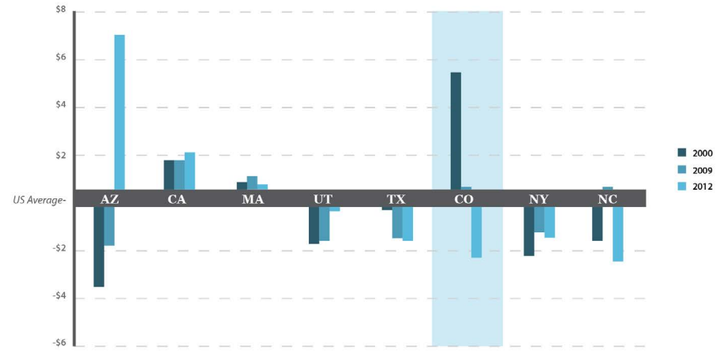


For startups, reputations have not been built and often little is known about the eventual probability of success, so banks may be hesitant to make such loans. Venture Capital (VC) investments come in the form of equity, as opposed to debt. Investors are often more willing to lend to riskier start-ups when given a more substantive incentive. VC funding allows the lender to share in generated profits more directly when the business does perform well. To measure states' willingness to invest in start-ups in the form of VC funding, we compare both the amount of VC funding as well as the average amount of funding per deal. The Great Recession hit VC funding particularly hard. The national average of VC funding has gone from close to $375 million per million people in 2000 to under $66 million in 2009 (Figure 29). However, there are signs of improvement in the recovery, with a jump back to nearly $85 million in 2012. Colorado went from being well above the national average in 2000 to just about average in the last few years, which is consistent with its peer group.

Figure 30:

Average Venture Capital Funding ($ millions) Per Deal
Relative to the United States

US Average		
2000	2009	2012
$15.27	$8.59	$10.14

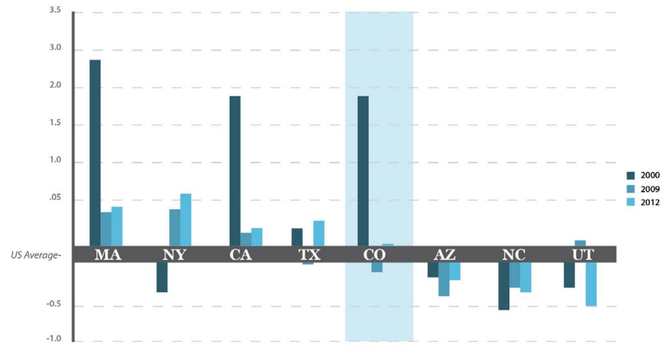


In terms of average VC funding, Colorado is now more than 15% behind the national average, again underscoring the funding gap for small businesses (Figure 30).

Figure 31:

Initial Public Offerings Per Million Residents
Relative to the United States

US Average		
2000	2009	2012
1.08	0.29	0.35



A further indicator of access to capital is an enterprise's willingness and ability to raise capital through Initial Public Offerings (IPO's). Data on IPO's is drawn from the Bloomberg database (Figure 31). As in the case of VC, Colorado has gone from a leader to merely average, as have most of the benchmark states.

CAPITAL

Figure 32:

Average Value of IPO
Relative to the United States

US Average		
2000	2009	2012
$176.58	$185.07	$469.44

To underscore the funding gap issue already highlighted in the loan and VC statistics, not only has the number of Colorado IPO's fallen precipitously but their average value has gone from somewhat below average to significantly so in the last dozen years (Figure 32). In general, there appears to be a significant funding gap in early-stage capital for Colorado businesses, precisely during the period when establishment survival faces its greatest struggles.

Financing entrepreneurial growth is a challenge not only in Colorado but nationwide. Nationally, the Jumpstart our Business Startups (JOBS) Act was intended to encourage funding of small businesses and ease various securities regulation however, while the Securities and Exchange Commission (SEC) is in process of finalizing rules that will lift the ban for private offering advertising, investment can still only be made by an accredited investor. Some states, such as Georgia, Kansas and North Carolina, have enacted securities exemptions that allow their states' entrepreneurs and small businesses to raise up to $1 million dollars via the sale of securities to residents of the state. Most recently, the state of Washington has followed this trend. While something to consider for the state of Colorado, the state enacted the Advanced Industries Accelerator Act last year, which incorporates grants for proof of concept, early stage and infrastructure as a means to further entrepreneurial growth within the state within seven advanced industries, including information and technology, infrastructure engineering, energy and natural resources, advanced manufacturing, bioscience, aerospace and electronics.

Colorado's Advanced Industry Accelerator Act

Author: Jeff Kraft, Colorado Office of Economic Development and International Trade

The State of Colorado has seven advanced industries (AIs) that are key drivers of our economy and the U.S. economy as a whole. These sectors include: advanced manufacturing, aerospace, biosciences, electronics, energy & natural resources, information & technology, and infrastructure engineering. Colorado also has additional strategic economic assets such as world class public research universities (the Airforce Academy, Colorado School of Mines, Colorado State University, and the University of Colorado System), Private Non-Profit Research Organizations (Bonfils Blood Center and National Jewish Hospital), more than 20 federal laboratories, and one of the most highly educated workforces in the United States.

This combination of sectors and assets has made Colorado one of the most technologically innovative states in the U.S. and offers the potential for the creation of powerful and dynamic ecosystems which could drive economic growth and prosperity. To help catalyze and maximize this economic activity, the State of Colorado passed HB 13-1001 in 2013, the Advanced Industry Accelerator Act (the Act).

The Act was based on a well regarded existing state economic development program in Colorado called the Bioscience Discovery Grant Evaluation Program (BDGEP), which was noted by Brookings to be emulated and expanded into other sectors. Both programs are premised on the idea that private capital markets tend to under invest in early stage technologies and companies (i.e. provide resources that are below a socially optimal level) and that certain types of infrastructure and industrial commons or public goods necessary for private sector competitiveness are under supplied by private entities. This under-investment, known as a "market failure," is driven by factors like indivisibilities (a relatively large scale of resources with high fixed costs are necessary to undertake even small amounts advanced technological research causing a barrier to entry for smaller innovative companies), positive spillover effects or externalities and public goods make it difficult for private entities to capture all the benefits of their innovation, and a high degree of uncertainty exists about the economics and viability of emerging technologies. There are also systems failures or informational and organizational frictions which prevent the ecosystems of public and private entities from collectively optimizing their resources.

One policy solution is for government entities to stimulate incremental capital formation and collaboration to support early stage technology investment through carefully tailored public investment programs which are designed to overcome the underinvestment market failures and provide an organizing mechanism which brings together the private sector, strategic research assets, non-profit entities and public resources to collaborate and identify technology challenges, solutions and breakthroughs.

The Act allows for three different types of non-dilute public investments or grants to catalyze advanced industries, each of which addresses different technology lifecycle stages or aspects of the capital market and innovation systems failures mentioned above. The three grant types – Proof of Concept, Early Stage Capital and Retention and Infrastructure – are described in the table below. Although each grant type has certain maximum or capped amounts per grant, these caps can be lifted if a project meets the statutory preferences described below and leads to collaboration across research institutes or across advanced industries.

By leveraging the state's existing strengths and assets, providing capital to fund nascent technology commercialization and business formation, energizing the innovation ecosystem and promoting the alignment of resources and strategies across key economic stakeholders in industry, research, capital markets and government, the Advanced Industry Act holds great promise to help build the Colorado economy.

	Proof of Concept	Early Stage Capital and Retention	Infrastructure
Purpose	Supports researchers in commercializing their work through: proof of principal creation, intellectual property creation, prototype building and technical validation, market assessment and legal start-up costs	Provides non-dilutive seed funding to early stage companies to help them survive the funding "Valley of Death" and prepare for VC funds by developing products and services that will be produced in Colorado	Common service or support structures that impacts across the AI ecosystem to support or enhance the commercialization of AI products and services or help develop the AI workforce
Required Match	**One Third**	**Two to One**	**Two to One**
Grantee Type	Colorado Based Research Institution or Federal Lab with TTO or Private Lab	Early Stage Company Located in Colorado	Non-Profit Entity or private company which provides infrastructure
Eligibility	Economic or competitive impact for State AIs and accelerate product commercialization	Less than $20M in other funding Less than $10M in revenue	Project must increase alignment between private companies and research institutions
Statutory Preferences	Projects that include more than one AI, more than one research institution, or originate from nonprofit research institution	Companies whose technology and R&D apply to more than one AI	Common service or support structures that impacts across the AI ecosystem to support or enhance the commercialization of AI products and services or help develop the AI workforce
Maximum Amount Per Grant ***	$150,000	$250,000	$500,000

***No hard cap on grant if the grant qualified for statutory preference

CONCLUSION

As shown in last year's inaugural report, Colorado is earning its reputation as a leader from an innovation perspective. While there is cause for celebration of the accomplishments being awarded across the state, there is a clear need to go beyond the surface and anticipate future challenges and implications on the innovation ecosystem in Colorado in order to maintain our innovative competitiveness. This report addresses that need by highlighting opportunities to enhance the state's Talent, Ideas, Capital and Entrepreneurship.

Micro-entrepreneurs are an emerging trend in the U.S. economy, both in their non-employer form as well as in the smaller size of employer establishments. Colorado shares many of these national trends and traits. The trajectory of recovery since the depths of the Great Recession has only reinforced many of these trends. The type of support the findings suggest may be broadly useful to all entrepreneurial businesses, whether employer or non-employer, helping to boost job growth. Non-employer establishments create jobs directly for their proprietors, while also creating a seedbed for potential employer establishments and consequent additional employees as these owners grow their enterprises.

Colorado establishments struggle to survive their early years, yet are as a whole rebounding smartly from the Great Recession. Those that do survive generate both jobs and returns in excess of national benchmarks. The overall prospects for entrepreneurial non-employer and employer establishments are critically shaped by the three components that generate raw innovations, but Colorado is facing headwinds in crucial flows of Talent and Ideas while also facing constraints in Capital provision.

Support for the state's innovative ecosystem through Talent, Ideas, Capital and Entrepreneurship is not intended to artificially sustain marginal businesses, but rather to maximize the chances that competitive companies make the vital step from innovative startup to stability. Together, innovation creation and entrepreneurial momentum can spearhead Colorado's economic successes in the global marketplace of the 21st century.

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Data

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